



Surviving MODIS: Perspectives from an Aerosol Forecaster

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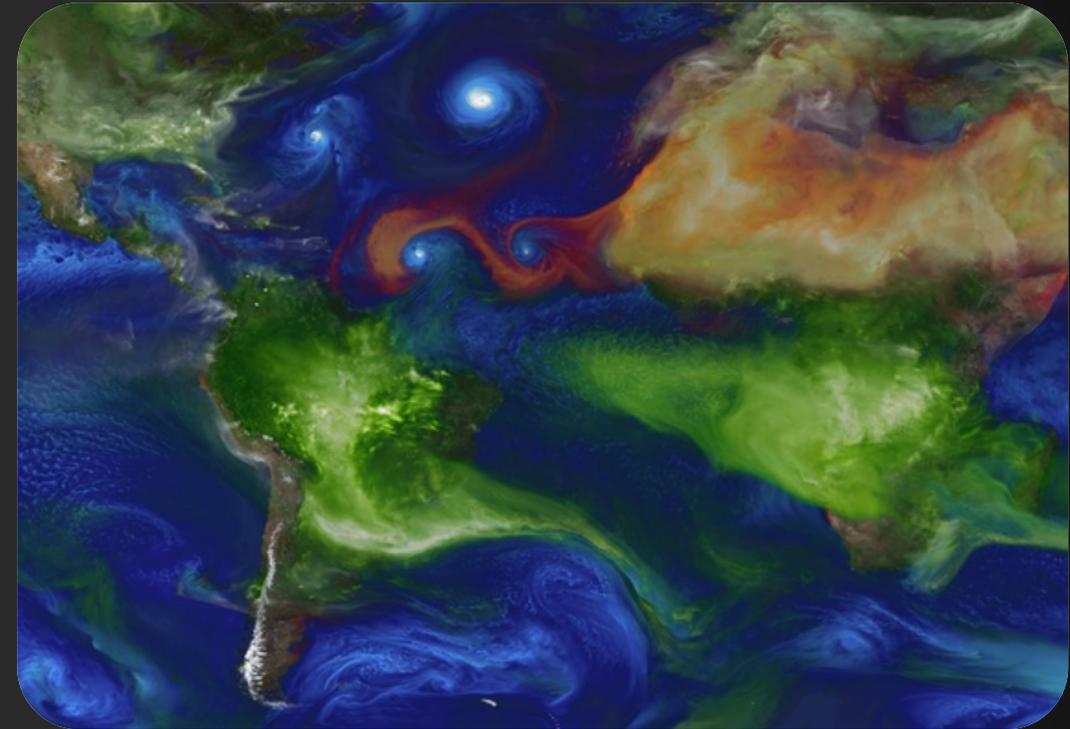
MODIS-VIIRS Science Team Meeting

4 May 2023

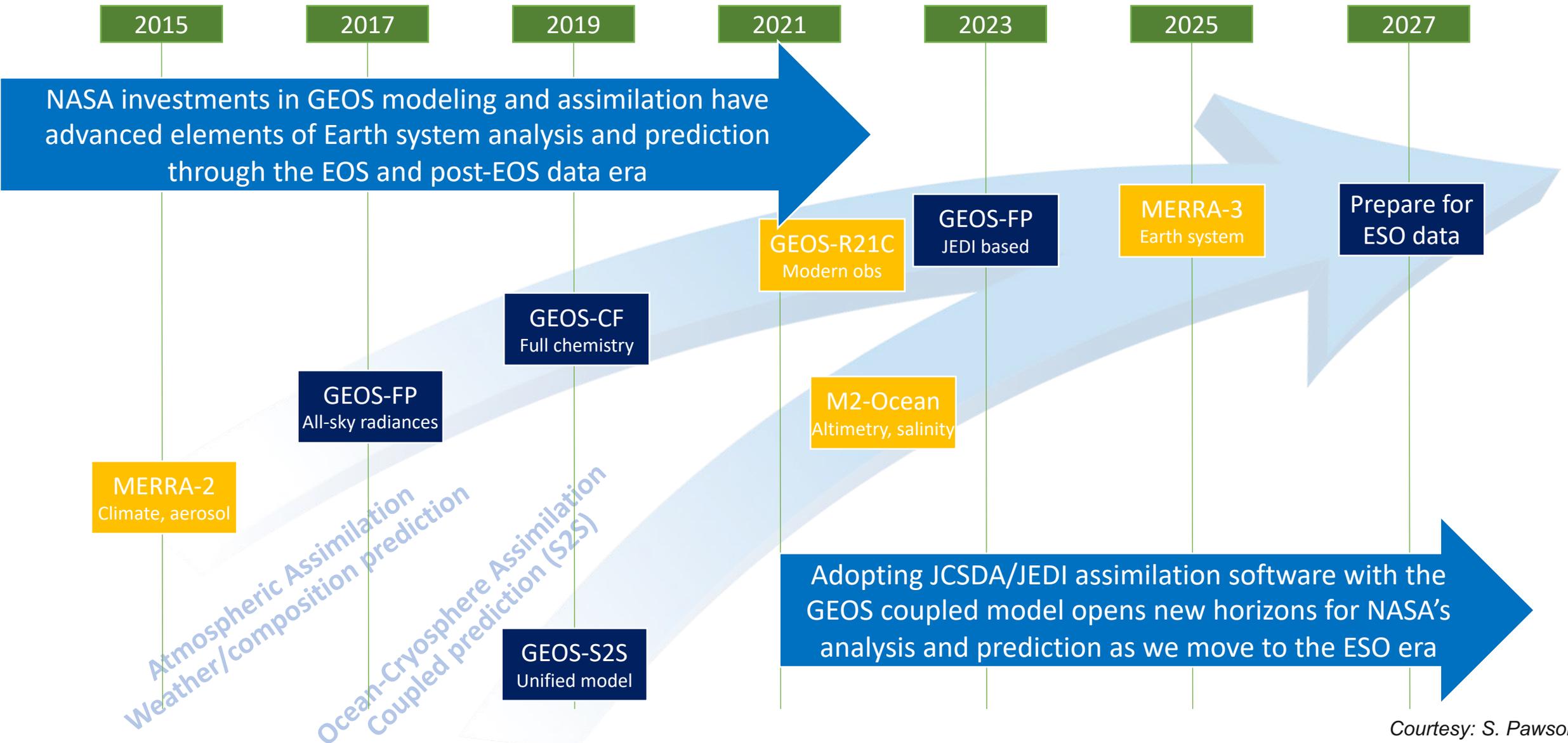


Outline

- MODIS at GMAO:
 - QFED: Biomass emissions
 - Aerosol Optical Depth
- ICAP Community
- MODIS Continuity
 - PM: MODIS → VIIRS continuity
 - AM: OLCI/SLSTR, METimage
- The role of geostationary
- Summary



Timeline for GEOS Systems

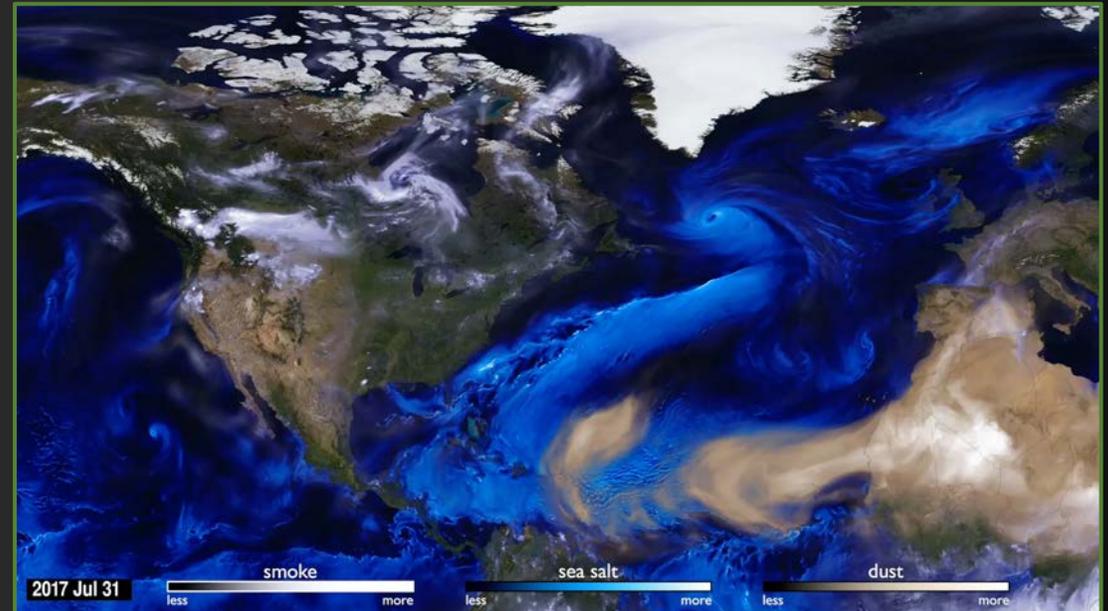


Courtesy: S. Pawson

Assimilation of Dark Target/Deep Blue Aerosol Products in GEOS



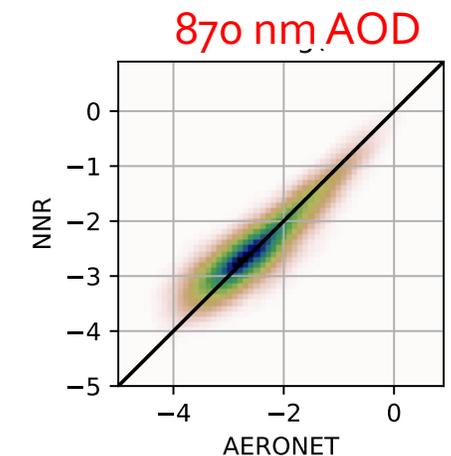
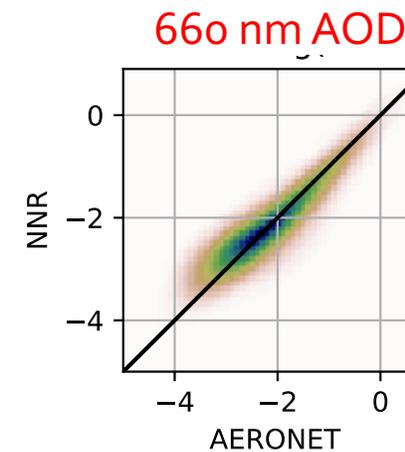
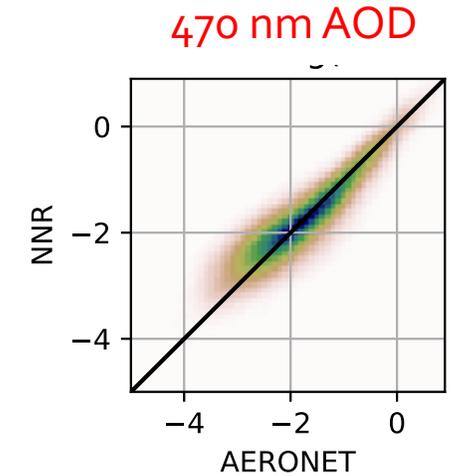
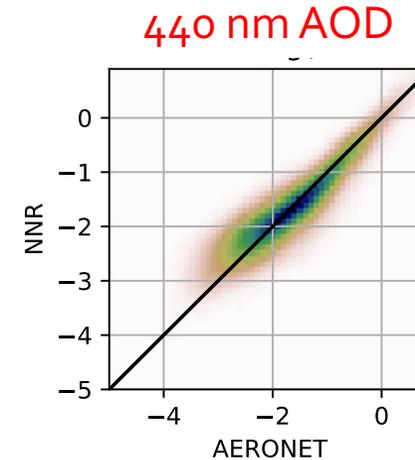
- MODIS DT/Deep Blue products are assimilated in GEOS NRT system and in the MERRA-2 reanalysis; **VIIRS in progress**
- DT/Deep Blue products are very convenient for assimilation in GEOS
 - Provides *cloud cleared/gas corrected* reflectances used for the retrieval (at ~10 km product resolution)
 - Product files are in NetCDF/HDF format
 - Variable names similar to MODIS
- Currently testing **ABI on GOES-16/17**, and **AHI on Himawari-8** in 2019 during FIREX-AQ and CAMP²EX airborne campaigns
- Observations of diurnal aerosol!





Observing System Homogenization

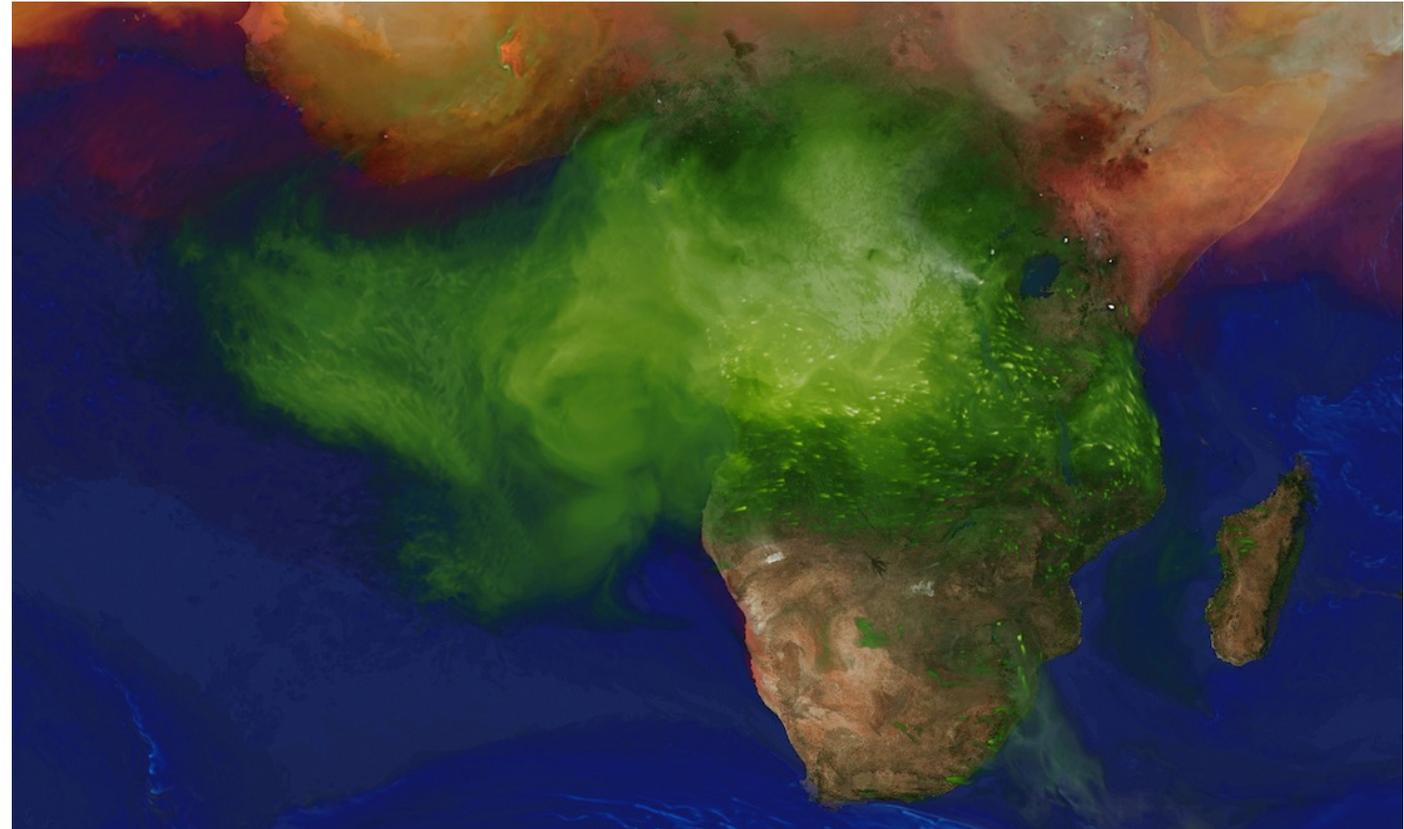
- AERONET provides the calibration reference
- Originally developed Neural Net for bias correction of physical retrievals
- Currently, multi-channel Neural Net Retrieval (NNR) trained on AERONET
- Multi-channel AOD derived from multi-channel *Level 2 Reflectances*, no dependency on *aerosol model*
- VIIRS NNR algorithm in testing





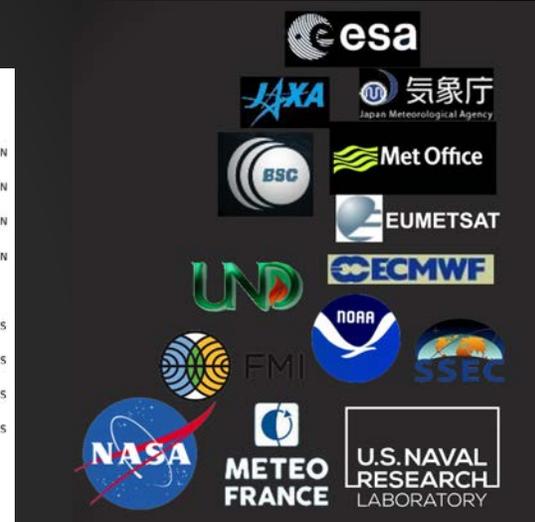
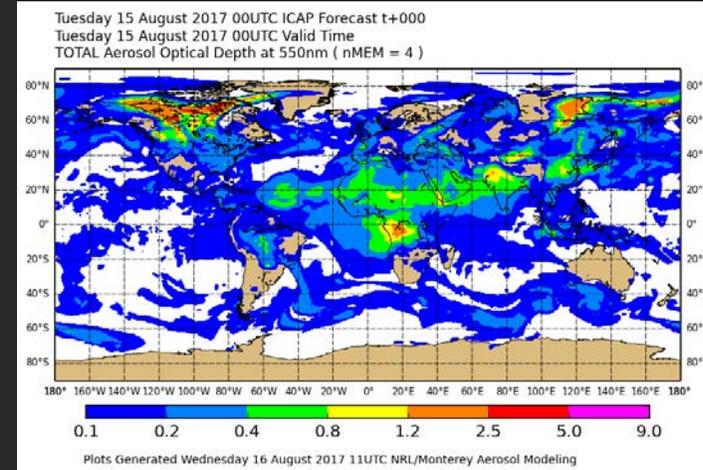
QFED: Quick Fire Emission Dataset

- Top-down algorithm based on MODIS Fire Radiative Power (AQUA/TERRA)
- FRP Emission factors tuned by means of inverse calculation based on MODIS AOD data.
- Daily mean emissions, NRT
- Prescribed diurnal cycle
- VIIRS FRP being evaluated, to eventually include estimates of Modified Combustion Efficiency
- Geostationary FRP for adaptive diurnal cycle estimation

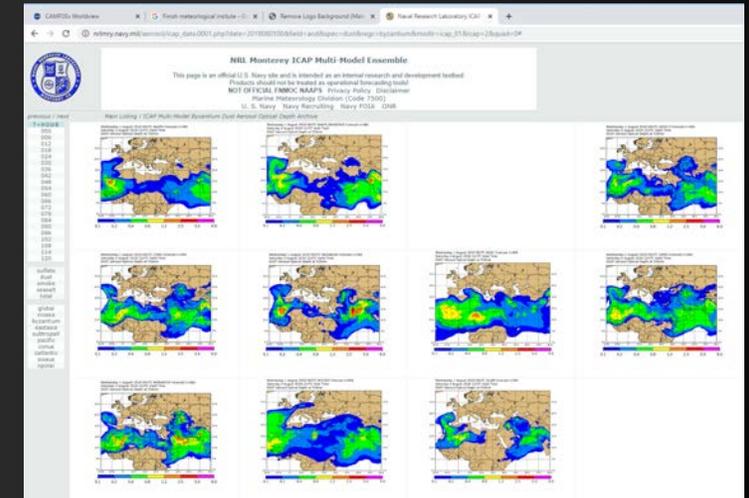




- By now, most major global centers have some form of NRT aerosol prediction
- Originated from a 2010 ad hoc meeting between model & remote sensing developers concerned with the transition from the MODIS to the VIIRS era. Discussions continue until today about all manner of aerosol modeling, remote sensing, and data assimilation problems.
- Given global reciprocity needs, developers agreed to begin collaborative aerosol research on satellite QA/QC, verification, and consensus/multi-model ensemble to diagnosing data requirements.
- ICAP members do not speak for their agencies, but ICAP allows developers to speak as a community to establish best practices and make scientific recommendations
- Model members: BSC, ECMWF, FMI, JMA, GMAO, MeteoFrance, NCEP, NRL, UKMO.
- Remote sensing members: JAXA/JMA, ESA, Eumetsat, NASA, SSEC



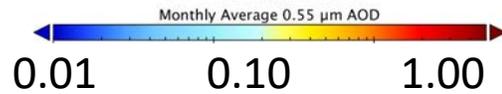
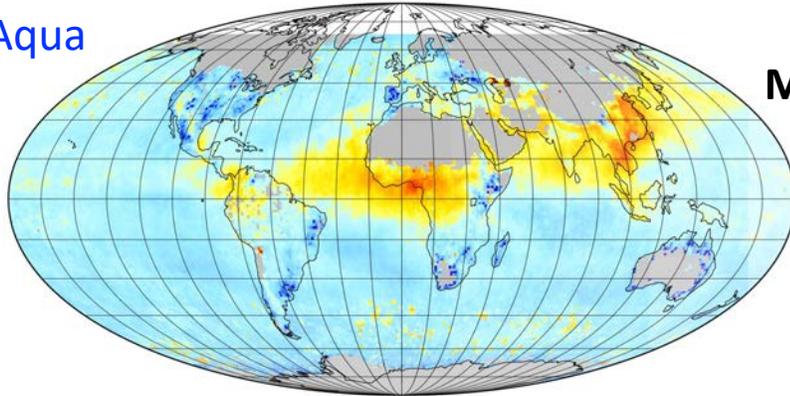
ICAP Multi-mode Ensemble



PM Orbit: VIIRS Continuity Algorithms

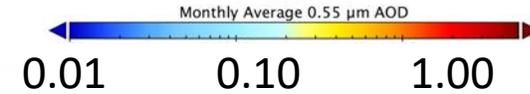
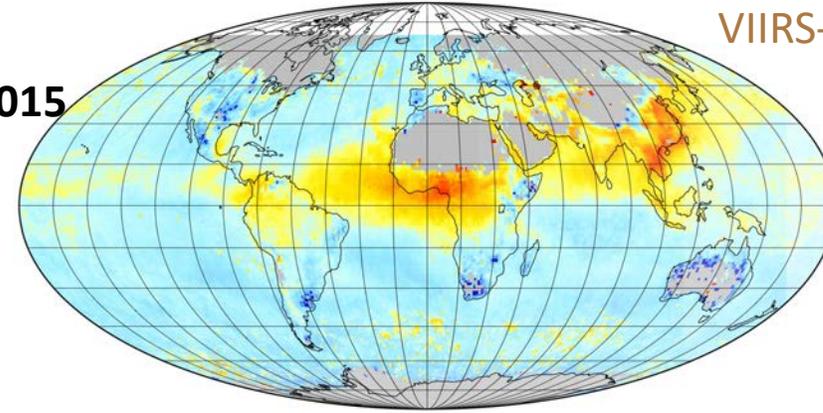
QA-Filtered Aerosol Optical Depth, MODIS Aqua C6.1, March 2015

MODIS-Aqua



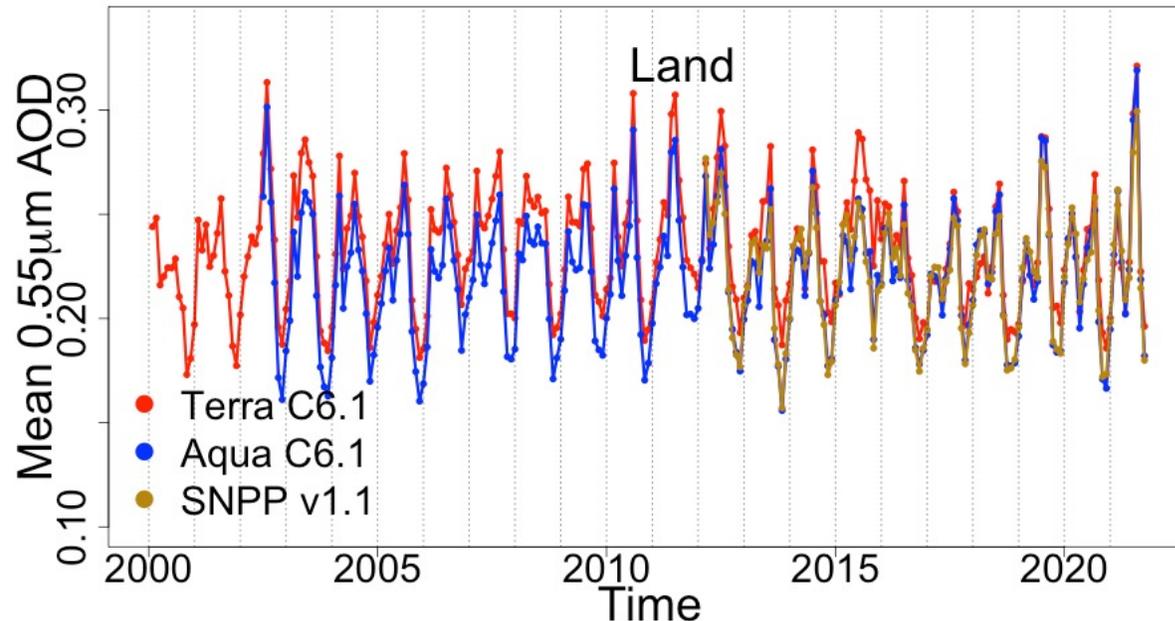
QA-Filtered Aerosol Optical Depth, VIIRS SNPP v1.1, March 2015

VIIRS-SNPP



March 2015

Similar continuity
Products from
Deep Blue and
MAIAC algorithms



VIIRS-SNPP

MODIS-Aqua

“funded” to continue on VIIRS-
JPSS-1/NOAA20 (≥2021)

What about a replacement for Terra?

- A combination of **OLCI** and **SLSTR** on Sentinel-3 provide necessary channels for implementation MODIS aerosol continuity algorithms
- **METimage**: Visible + IR passive radiometer on EUMETSAT METOP-SG will provide VIIRS continuity in the AM orbit
 - Launch NET **2025**
- No funding currently exists for developing such algorithms.

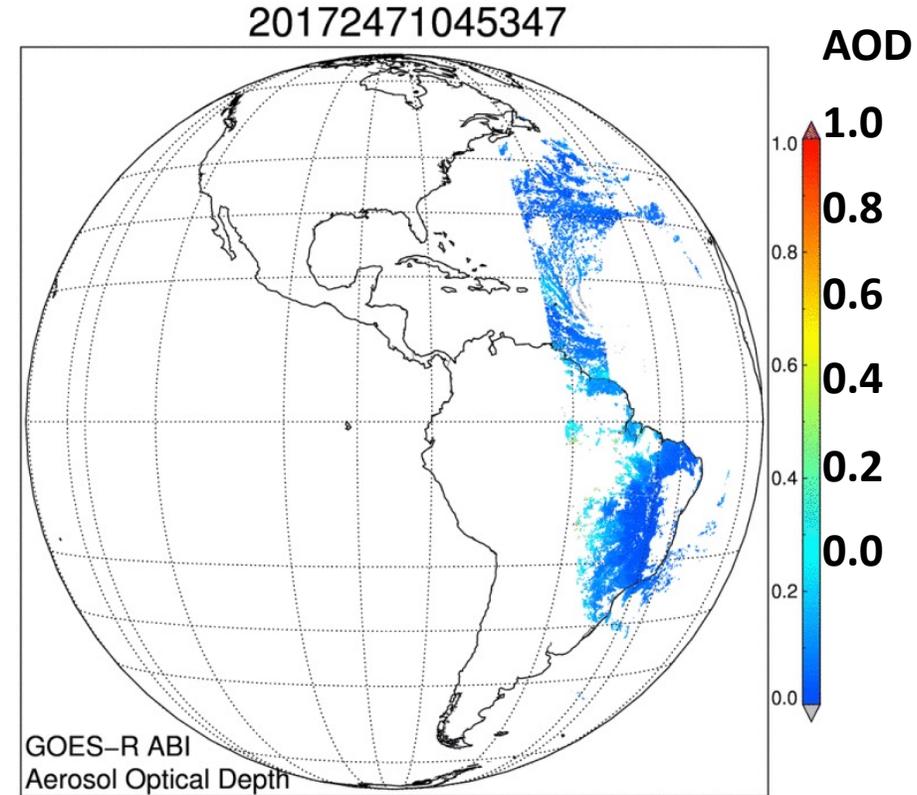
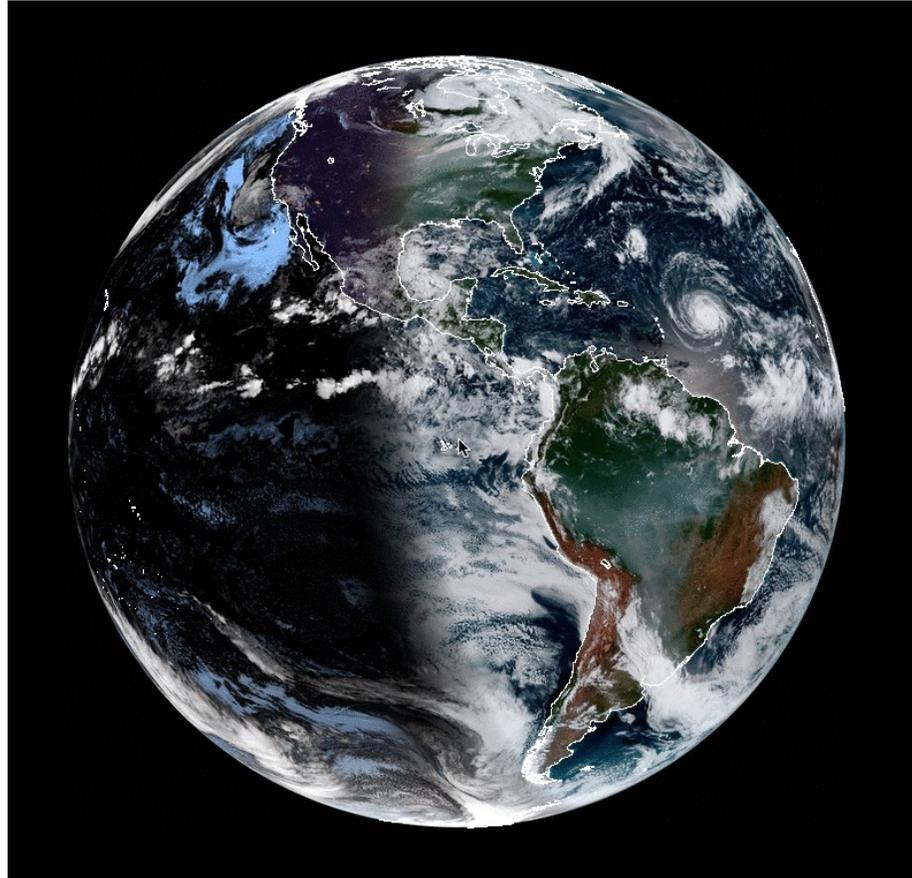


Sentinel 3 Ground Track (credit: ESA)



Expanding to retrieve from GEO-Imager data!

RGB and AOD from ABI for Sep 4, 2017 (animation)
Canada/Washington fires and smoke mega-event



ABI = Advanced Baseline Imager

- Polar Orbiting Satellites: 1-3 observations per day, per sensor, cannot resolve diurnal cycle
- Current Geostationary Satellites: Every 10 min (Full Disk). Can resolve time

Summary

- MODIS has been the workhorse for most aerosol forecasting systems, providing aerosol optical depth for DA and FRP for biomass burning emissions – it will be missed!
- VIIRS with the corresponding MODIS continuity algorithms answers the mail for the PM orbit
- A gap exists for the AM orbit
- The advanced geostationary imagers will provide temporal information on the GeoRing, but lacks polar coverage

